PATENT SPECIFICATION

DRAWINGS ATTACHED

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COMPLETE SPECIFICATION

Improvements in or relating to Analytical Balances.

I, ERHARD METTLER, trading as E. METTLER, FABRIK FÜR ANALYSENWAAGEN, of Grundstrasse, Stafa, Switzerland, do hereby declare the invention for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

Analytical balances are known wherein the base, which is provided with feet, carries the balance housing. At a certain height above the base is an intermediate support which rests on the side walls of the balance housing. The bearing for the centre knife-edge of the balance beam and the device for reading off the last decimals of weight given by the inclination of the beam, which device generally works optically, are mounted on this intermediate support. A removable cover is placed over the upper end of the balance housing projecting above the intermediate support. The two scale pans, which are suspended on the balance beam, are housed in the interior of the balance housing in the space below the intermediate support. The weights and the article to be weighed are introduced and extracted respectively through doors provided in the housing walls.

In analytical balances with mechanically actuated control weights, the second pan is generally omitted and the space beneath the intermediate support which becomes free as a result is used for the reception of auxiliary devices such as a power transformer, forming part of the arresting mechanism for arresting the balance beam. In those analytical balances the balance beams of which comprise three knife-edges, the control weights and the mechanism for actuating the control weights are arranged in the space beside the pan. The interior space in the housing which encloses only the scale pan is separated from the adjoining housing compartment containing these auxiliary devices by means of a partition wall.

It has now been found that this usual construction of high-precision analytical balances may lead to some disadvantages in extreme operating conditions. In the first place, the heat expansion of the various housing walls is never precisely the same because considerable differences in temperature may appear at them because of their large surface areas. A great difference in the expansion of the housing walls, however, generally leads to corresponding variations in the inclination of the intermediate support, as a result of which there are unwanted variations in the zero point. Moreover, depending on the type of construction of the balance housing, mechanical stresses may occur as a result of different heat expansion which stresses are transmitted to the intermediate support and have a disadvantageous effect. Furthermore, because of the large total volume enclosed by the whole balance housing, it is a comparatively long time before thermal equilibrium is established and high-precision weighing can be started.

Accordingly the present invention provides an analytical balance in which a balance beam and a device for determining the inclination of the beam are mounted on an intermediate support supported above a scale pan by means of a plurality of exposed columns, in which a housing is provided beneath the intermediate support, which housing encloses a space between the columns, contains the scale pan and incorporates a door providing access to the scale pan; and in which balance a further housing is provided above the intermediate support, which further housing encloses the balance beam and the device for determining the inclination of the beam. The exposed columns extending downwards from the intermediate support are preferably secured at their lower ends to a base which extends underneath the scale pan. The housing surrounding the scale pan is then preferably supported on said base, while the housing surrounding the balance beam and the device for determining the inclination of the beam is secured to the intermediate support, prefer-

ably in a removable manner. A very practical construction of the analytical balance is obtained if the intermediate support stands on three downwardly extending exposed columns, in which case, looking at the balance in the position of use, two columns are provided at the front, one on each side of the housing surrounding the scale pan, while the third column extends centrally behind the housing surrounding the scale pan.

One embodiment of the present invention is illustrated in perspective, by way of example, in the accompanying drawing. The analytical balance comprises a base 1 in the form of a plate with an intermediate support 2 extending above this. The intermediate support is carried by three columns 3 to 5 which are secured at the top in the intermediate support 2 and at the bottom in the base 1. The columns 3 to 5 are exposed and preferably consist of tubes as illustrated by the column 3 which is shown broken. The whole balance stands, in the usual manner, on three feet 6 to 8 and in the present case these are arranged in such a manner that they extend in the extension in the of the axes of the columns 3 to 5. The two front feet 6 and 7 may be of adjustable construction and may, for example, have screw spindles which penetrate partially into the hollow columns 3 and 4 where they are guided. The rear foot 8 is then of fixed or non-adjustable construction. Finally, a spirit level may be mounted in the intermediate support 2 so that the analytical balance can be levelled accurately.

Mounted on and secured to the intermediate support 2 is a housing 9 which is preferably removable and which surrounds the basic mechanism of the analytical balance. The broken away portion of the housing 9 shown in the drawing reveals the balance beam 10 which is asymmetrical in construction. The longer arm of the balance beam carries a fixed counterpoise 11 and is provided with a graduated dial 12. In order to be able to read off the last decimals of the weight of the article to be weighed, which decimals are given by the particular inclination of the balance beam 10, the graduated dial 12 is illuminated by a lamp which is not illustrated but which is inside the housing 9. The part of the graduated dial 12 which is in the optical axis is reproduced in a known manner, by means of the magnifying optical system 13 and the deflecting mirror 14 on a ground-glass plate 15 which is in the front face of the housing 9. The other mechanisms of the balance, such as the optical zero-setting, the arresting mechanism, the control mechanism for the mechanical placing in position or removal of control weights etc., are not illustrated in detail in the drawing; they are, however, likewise inside the housing 9 and are actuated by means of the operating knobs 16 to 19.

Mounted on the end knife-edge of the shorter arm of the balance beam 10, only part of which is visible, is the usual suspension which comprises, at the end below the end knife-edge of the balance beam, the hook for the suspension of the stirrup 21 carrying the scale pan 20. The intermediate support 2 has an appropriate aperture in its bottom through which said hook projects freely downwards. The pan 20 is surrounded by a housing which extends substantially in the space between the columns 3 to 5 and between the base 1 and the bottom of the intermediate support 2. This housing, which surrounds the weighing compartment, comprises a glass wall 22 which is curved substantially in a semicylinder and secured in the base 1 and which, in conjunction with the further curved glass wall 23 completely surrounds the pan 20. The curved glass wall 23 is secured to a plate 24 which is mounted for rotation in the base 1 and which extends underneath the pan 20 and, together with the glass wall 23, constitutes a door through which the article to be weighed can be introduced or taken out. The housing 22 to 24 which surrounds the weighing compartment is further provided with the usual seals which are intended to make it difficult for dust to penetrate; for the sake of clarity, however, these seals are not illustrated.

When the analytical balance is in the position of use, the narrow side is in front of the operator so that it is possible to look directly at the ground-glass plate 15, and the two columns 6 and 7 are one on each side of and in front of the housing 22 to 24.

A particular advantage of the construction of the analytical ballance as described consists in the fact that the articles placed on the pan 20 or on the turntable 24 can be observed from all sides and the whole weighing compartment is clearly visible. A further advantage is the fact that there are no walls or the like casting shadows and there is the possibility of additionally illuminating the weighing compartment without glare by means of a lamp placed beside or behind the analytical balance. The intermediate support 2 on which the essential mechanisms of the balance are mounted, has a free flow of ambient air round it. In conjunction with the comparatively small volume of air enclosed by the housing 9, therefore, the thermal equilibrium necessary for high-precision weighing is very quickly established. Finally, the heat expansion of the columns 3 to 5 can be made precisely equal without difficulty so that, in the event of variations in temperature, the intermediate support 2 does not undergo any variation in its inclination which would lead to fluctuations in the zero point. As a result of the uniform and unhampered expansion of the columns 3 to 5, no restraint forces can act on the intermediate support 2, which would lead to mechanical stresses. Bearing in mind all the measures described, a construction for analy-

tical balances is obtained which displays not only great accuracy but also very constant operating conditions.

Modifications of the analytical balance described which likewise make use of the invention, are perfectly possible. For example, the base 1 could be omitted entirely, the housing 22 to 24 surrounding the pan 20 suspended from the bottom of the intermediate support 2 and the intermediate support 2 placed directly on the columns 3 to 5 provided with the feet 6 to 8. There would then be a danger, however, that in the event of the action of forces spreading the feet 6 to 8 apart—such as might occur in the event of displacement of the balance on an uneven surface—mechanical stresses may occur in the intermediate support 2 which are undesirable in themselves. The use of a base 1, which locates the columns 3 to 5 at their lower ends and so directly takes up the restraint forces mentioned above, has therefore proved better. The base 1 need not, however, be in the form of a continuous plate and a base 1 in the form of a triangular or star-shaped framework which braces the lower ends of the columns 3 to 5 is also conceivable. The housing 9 and the intermediate support 2 need not necessarily have the simplified form shown in the drawing. With the object of making the volume of air enclosed by the housing 9 and the intermediate support 2 as small as possible, it may be preferable to provide bays or the like so as to fit closely round the mechanism. The same considerations also lead to constructing the balance housing 22 to 24 in the form of a housing which is narrowed in a taper towards the top as shown in the drawing. For practical reasons, such housing shapes necessitate mounting the housing portion 22 to 24 on the base 1 of the balance.

WHAT I CLAIM IS:—

1. An analytical balance in which a balance beam and a device for determining the inclination of the beam are mounted on an intermediate support supported above a scale pan by means of a plurality of exposed columns, in which a housing is provided beneath the intermediate support, which housing encloses a space between the columns, contains the scale pan and incorporates a door providing access to the scale pan, and in which balance a further housing is provided above the intermediate support, which further housing encloses the balance beam and the device for determining the inclination of the beam.

2. An analytical balance as claimed in claim 1, in which the columns are secured at their lower ends to a base which extends beneath the scale pan.

3. An analytical balance as claimed in claim 2, in which the housing which encloses the scale pan is supported on the base, and in which the further housing is secured to the intermediate support.

4. An analytical balance as claimed in any preceding claim, in which the further housing is detachably secured to the intermediate support.

5. An analytical balance as claimed in claim 1, in which the intermediate support rests on three exposed columns and in which one of the columns is arranged on each side of and in front of the housing enclosing the pan and the third column extends centrally behind the housing enclosing the pan.

6. An analytical balance as claimed in any of claims 2 to 5, in which three feet projecting underneath the base extend in the extension of the axes of the columns.

7. An analytical balance as claimed in any preceding claim, in which the columns are constructed in the form of tubes.

8. An analytical balance substantially as described herein with reference to the accompanying drawing.

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887429 COMPLETE SPECIFICATION

1 SHEET *This drawing is a reproduction of the Original on a reduced scale*